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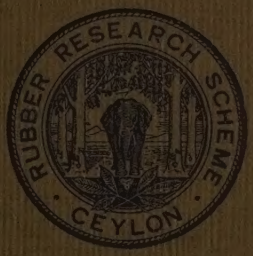
Combined Third & Fourth Quarterly Circulars for 1932.



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REGISTRATION FOR PUBLICATIONS OF THE RUBBER RESEARCH SCHEME (CEYLON.)

Bulletins, Quarterly Circulars and Leaflets published by the Rubber Research Scheme are issued without charge to the Proprietors, Superintendents and local Agents of Rubber estates in Ceylon who apply for their names to be registered for the purpose. Registration must be renewed at the beginning of each year.

Application for registration for 1933 should be made on the attached form and forwarded to the undersigned.

T. E. H. O'BRIEN,
Director of Research,
Rubber Research Scheme (Ceylon.)

Culloden,
Neboda,
January 15, 1933.

Registration for Publications of the Rubber Research Scheme (Ceylon.)

To

The Director of Research,
Rubber Research Scheme (Ceylon.)
Culloden,
Neboda.

Please register my name for issue of publications of the Rubber Research Scheme (Ceylon) during 1933.

Name.....

Address.....

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Qualification for registration:.....

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LIST OF CONTENTS.

Page

(1) Alternative Forms of Raw Rubber. By T. E. H. O'Brien, M.Sc., F.I.C., F.I.R.I., Director of Research, Rubber Research Scheme (Ceylon)... 29

(2) Importation of Rubber Budwood and Budded Stumps. By R. K. S. Murray, A.R.C.Sc., Mycologist, Rubber Research Scheme (Ceylon). 37

(3) Notes on the After-Treatment of Budded Rubber Stocks. By W. I. Pieris, B.A. (Hortic.) Cantab., Agricultural Assistant, Rubber Research Scheme (Ceylon) 43

(4) A Change-over Experiment in Rubber Tapping. By T. H. Holland, Dip. Agric. (Wye), Manager, Experiment Station, Peradeniya. ... 50

ALTERNATIVE FORMS OF RAW RUBBER

T. E. H. O'BRIEN, M.Sc., F.I.C., F.I.R.I.,
DIRECTOR OF RESEARCH,
RUBBER RESEARCH SCHEME (CEYLON)

THE present unremunerative condition of the rubber plantation industry has compelled producers to scrutinize costs of production very carefully and the question is frequently asked whether raw rubber cannot be marketed in some cheaper form than the present standard grades, smoked sheet and pale crepe. Although the question is mainly raised on the score of cost there is also the feeling that a great deal of trouble is taken to turn out rubber of good appearance whilst frequently some minor defect in appearance leads to a reduction in market value out of proportion to the effect of the blemish on the quality of the rubber. Planters also know that manufacturers are not altogether satisfied with the properties of plantation rubber and the question is sometimes put in the form of whether some cheaper *and* better form of manufacture can be devised.

The writer has spoken on matters arising from these questions at several Planters' meetings during the past few months and it is considered to be of interest to review the subject rather more fully than has been possible on those occasions.

PRESENT METHODS OF MANUFACTURE

It is considered necessary to separate the two questions enumerated above (a) whether cheaper methods can be devised; (b) whether methods giving a better product can be devised. In succeeding paragraphs it will be shown that existing methods can probably be adjusted to give a better product than at present and that there may be scope for marketing rubber in forms other than smoked sheet and crepe but it will become evident that alternative methods of preparation are not likely to decrease costs of manufacture.

In raising the question of adopting cheaper processes planters sometimes have in mind the possibility of reverting to a more primitive product such as the slabs of coagulum produced by the peasants of Sumatra and Borneo; the rather more refined "slab rubber" which has been shipped from certain estates to

fill special contracts; and the balls of "fine hard Para" which form the standard product of Brazil. It is overlooked that each of these products has to be milled and dried before use in manufacturing processes and that the effect of marketing these grades would merely be to transfer the milling process from the producer to the user. Since coagulum gradually hardens on keeping, the actual cost of milling would be correspondingly greater than that of machining raw coagulum.

For a market with an annual turnover exceeding half a million tons, such as the raw rubber market, it appears to be essential or at least a great convenience that the material should be marketed in a relatively dry condition in order to avoid contiual disputes regarding allowances to be made for variation of moisture content.

Consideration of the processes for making smoked sheet and crepe shows that the purpose of each type of machining is to bring the coagulum into a suitable form for efficient drying. In the case of sheet rubber the coagulum is squeezed out sufficiently thin to be dried reasonably rapidly over a wood fire. In crepe manufacture the rubber is rolled thinner since it is to be dried without heat and washing must be more thorough to prevent development of moulds, etc. in the absence of wood smoke. The colour of the material is of importance for certain uses so sodium bisulphite is added to crepe rubber to prevent darkening during drying and storage. It must be admitted that sodium bisulphite is not very effective in this direction since there is not much difference in the colour of crepe prepared with and without bisulphite after a year's storage.

If it is agreed that raw rubber can most conveniently be marketed in a dry form, (except for special products such as preserved latex) then the present form of manufacture must be regarded as quite logical and the only question is whether some cheaper way of preparing a dry product can be devised. In comparing the cost of present methods with possible alternatives the planter, who may unavoidably be producing under relatively inefficient conditions, is inclined to base his calculations on costs in his own factory whereas it would be more reasonable to take as a basis of comparison the cost of preparation of smoked sheet and crepe rubber under the most efficient conditions. Without going into any details the writer expresses the opinion that costs of present methods of manufacture under moderately efficient conditions need not exceed 1·00 cent per lb. for smoked sheet and 1·75 cent per lb. for crepe, without cost of packing cases but including depreciation on the basis of complete renewal of machinery every ten years. At present market prices this may appear a substantial item in cost of production but it is difficult to visualise an alternative process of manufacture which could be

reveal the presence of resting spores or mycelium. We may enquire, then, to what extent the possibility of introducing new disease agents with imported budwood is a real danger.

DANGER OF INTRODUCING NEW DISEASES

The possibility of fungi new to Ceylon being introduced with imported budwood is exemplified by the case of the strain *Phytophthora palmivora* referred to above, though its entry in this manner cannot be more than strongly suspected. The disease caused by this fungus has unfortunately caused considerable damage in budwood nurseries during the recent S. W. Monsoon, though it yields fairly readily to control measures. Owing to its wide-spread occurrence in Ceylon at the present time this disease, however, can clearly have no bearing on restriction of future importations. It is also uncertain whether the strain of *Phytophthora* in question has been responsible for all the cases reported. The indigenous strain of *Phytophthora palmivora*, although somewhat less virulent in this country than the imported strain, is also capable of causing a die-back of green shoots under favourable conditions.

The absolute inhibition of all *Hevea* imports from the Western Hemisphere is on account of a dangerous disease known as South American Leaf Disease whose causal fungus, *Melanopsammopsis ulei*, is fortunately confined to South America. Most of the diseases which occur in the other rubber-producing countries in the Eastern Hemisphere are known also in Ceylon, though they are not of equal importance in all countries. So far as is known the only diseases of consequence which occur further East but not in Ceylon are two in number:

1. Mouldy Rot of the tapped surface caused by *Sphaeronema fibriatum*, known in Malaya and the Dutch East Indies.

2. Wet Root Rot caused by *Fomes pseudoferreus*, which occurs only in Malaya.

The introduction of these two fungi on imported budwood is possible though it cannot be considered very probable. *Fomes pseudoferreus* might occur on the roots of budded stumps but would be unlikely to pass the inspection in the country of export. (In this connection it is of interest to record that the introduction into Indo-China of budded stumps infected with certain root disease has been reported).

The possibility must also be borne in mind of a fungus, which is a weak parasite in its native country, becoming strongly parasitic and possibly dangerous under the different ecological conditions of the country to which it is introduced. Thus the fungus causing a certain disease in, say, Java may be a different

biological strain to that causing similar symptoms in Ceylon. The former, on introduction from Java to Ceylon, might become more virulent than either its counterpart native to Ceylon or itself in Java.

It is thus clear that with the present system of almost unrestricted imports the danger of the introduction of new diseases must always be present. In the last section of this report the possible methods of safeguarding the rubber areas in Ceylon against new diseases are briefly considered.

PROTECTIVE METHODS

There appear to be two means by which the entry into Ceylon of disease organisms could be prevented more surely than under existing regulations:

(1) Absolute inhibition of the importation of *Hevea* budwood, budded stumps and seed.

(2) Disinfection of all imported material.

(1) INHIBITION OF IMPORTS

Inhibition of the importation of all *Hevea* material would be a very drastic measure, clearly attended by many objections. It is only necessary to state that such a measure would preclude Ceylon growers from obtaining any of the improved planting material which will become available in Malaya and the Dutch East Indies during the next few years. It is certain that better foreign clones than those at present known will come on the market during the next few years and, until proved Ceylon material is available, budwood or budded stumps from these clones will be required for new plantings and rejuvenation. It is submitted that such a drastic action could only be recommended to Government if there was a likelihood of any disease being introduced which would be a real menace to the plantation industry. At the present time there appears to be no cause for apprehension on this account.

(2) DISINFECTION

The consideration of recommending legislation to enforce the disinfection of budwood and budded stumps before import must await results of further investigation into disinfecting methods. At the present moment no work is being conducted along these lines in Ceylon owing to shortage of staff, but it is understood that the subject is receiving the attention of the Rubber Research Institute of Malaya. In this matter it may be found desirable to follow the lead of the latter country.

It is unnecessary in this report to deal with the practical problems in connection with any disinfectant treatment. Whether the disinfecting is carried out in the country of export or

import such difficulties are not likely to prove insuperable. When a suitable treatment is found it is possible that all countries which are exporting or importing *Hevea* material may introduce regulations for disinfection. In the meantime there appears to be no special cause for fearing the introduction into Ceylon of new diseases, and, at the present juncture, any restriction placed on the import of high yielding material is to be deprecated.

SUMMARY

1. This report has been written on the instructions of the Board of Management of the Rubber Research Scheme, arising from a suggestion that the importation of *Hevea* budwood and budded stumps should be prohibited in order to prevent the introduction into Ceylon of new diseases.

2. This matter received previous consideration in 1929 as the result of the suspected introduction from Java of a virulent strain of *Phytophthora palmivora*. This fungus has since caused considerable damage to young shoots in budwood nurseries.

3. Experiments have been carried out in Ceylon and Malaya with a view to finding a method of disinfecting budwood which is cheap, easy, effective and harmless. This work has not yet reached a stage at which any definite recommendations can be made.

4. The existing regulations governing the importation of *Hevea* material constitute an adequate safeguard against the entry into Ceylon of any material on which disease has developed, but they do not ensure the exclusion of harmful organisms in a dormant state.

5. Although it is suspected that the die-back of bud-shoots caused by *Phytophthora palmivora* originated from imported budwood, this disease is now so wide-spread in Ceylon that it cannot be regarded as having any bearing on future importations.

6. There is always the possibility of new disease organisms being introduced with imported material, but there is at present no cause for special apprehension on this account.

7. There are two alternative methods of further safeguarding the Ceylon rubber industry against the introduction from other countries of new diseases.

(1) Absolute prohibition of the importation of all plants or parts of plants of *Hevea*. It is submitted that such a drastic measure could only be justified by the existence in any exporting country of a disease which, if introduced to Ceylon, would constitute a serious menace to the health of the plantations.

(2) Disinfection of all imported *Hevea* material. When a suitable disinfecting treatment is discovered such a measure may prove a desirable and practicable addition to the present regulations.

8. It is submitted that any unnecessary restriction placed on the entry into Ceylon of high yielding material is, at the present time, highly undesirable.

R. R. S. Laboratories,
Culloden, Neboda.

22nd, October, 1931.

that the latter type of product will have the more general application in industry. A third method of concentrating latex, by adding a chemical which induces "creaming", is being tested experimentally in Malaya but so far a rubber content exceeding 45-50 per cent. cannot be relied on.

At present there is a steady demand both for ordinary ammoniated latex and for concentrate but it appears probable that the main demand in the future will be for concentrated latex, both on account of the saving in shipping costs and the fact that many of the new applications of latex require the use of the concentrated material. The Dunlop Company has indicated its willingness to issue licences for the use of the centrifugal process and enquiries are in hand regarding the supply of a machine for trial in Ceylon.

The cost of preparing ammoniated latex for shipment depends largely on the scale on which the process is worked. Small shipments of latex are usually made in kerosene tins packed in crates, the preservative being used in the form of "strong liquid ammonia". The cost of preparation and packing amounts, in this case, to 8-9 cents per lb. of rubber. If ammonia gas, purchased in cylinders, is used and the latex is shipped in 40-gallon drums the cost of preparation falls to $3\frac{1}{2}$-4 cents per lb. To these figures must be added the extra cost of shipment as compared with other grades of rubber. No figures are available for the cost of concentrating latex by the centrifugal process but it is likely to be slightly higher than that of ordinary ammoniated latex prepared under efficient conditions.

Rubber in latex form is therefore a more expensive product than crepe or smoked sheet and is only profitable to produce if it sells at a satisfactory premium over other grades. At present latex rubber sells at a premium of approximately 2*d*. per lb. on the London market so there is a fair margin if economical methods of preparation are adopted.

NEW PROCESSES AND UNIFORMITY

In an earlier paragraph it was pointed out that the main defect of plantation rubber is its lack of uniformity which could largely be remedied by standardising methods of manufacture and by bulking the latex from large areas. If any new processes of manufacture are introduced in Ceylon, such as the preparation of concentrated latex, rubber crumb or rubber powder, the writer considers it essential that they should not be adopted by individual estates but that co-operative factories should be established so that latex from considerable areas can be bulked and the method of manufacture efficiently controlled, thus assuring the production of a uniform material. The application of this

principle either to existing or new processes would do much to remove the stigma of variability which is at present associated with plantation rubber.

SUMMARY AND CONCLUSIONS

1. New processes of manufacture of raw rubber are not likely to prove cheaper than existing methods if the latter are carried out under efficient conditions. Adoption of new processes may be justified by an enhanced market value of the product.

2. The uniformity of rubber prepared by existing processes can be improved by standardisation of methods and by bulking the latex from large areas. Thin air-dried sheet has been suggested as a substitute for crepe for manufacture of light coloured articles.

3. Rubber powder and rubber crumb are novel products with interesting possibilities of development but at present both the preparation and utilisation of the materials are at an experimental stage.

4. The direct use of latex in industry has increased rapidly in recent years and continued development is expected. The main demand in the future is likely to be for concentrated latex.

5. If new processes are adopted in Ceylon it is important that co-operative factories should be established to ensure bulking of latex from considerable areas and the production of a uniform material.

REFERENCES

(1) The Rubber Research Scheme (Ceylon)—*Bulletin* 52. The Preparation of Uniform Rubber.

(2) The Rubber Research Scheme (Ceylon)—*Bulletin* 51, The Curing of Sheet Rubber.

R. R. S. Laboratories,
Culloden,
Neboda,

IMPORTATION OF RUBBER BUDWOOD AND BUDDED STUMPS

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dormant state on budwood which was itself quite healthy, and that the most careful inspection would not reveal such an external "infection".

In this connection it is of interest to quote Resolution No. 5 of the Second Imperial Mycological Conference held in September 1929. "The Conference suggests that the attention of the Governments of Malaya and Ceylon should be drawn to the desirability of investigating the possibility of treating budwood of rubber against diseases before import".

EXPERIMENTS IN CEYLON AND MALAYA

Experiments were started in Ceylon towards the end of 1929 with a view to finding an effective and practicable means of disinfecting budwood, but unfortunately pressure of other

work has prevented these experiments being carried to a conclusion. For a full summary of this work reference may be made to a memorandum issued in July 1930, which constitutes an interim report of the work carried out up to that date, and sets forth some of the practical considerations in connection with the application of any disinfectant treatment.

Briefly stated, the most satisfactory results were obtained by dipping the budwood for 5 minutes in weak solutions of copper sulphate, this treatment being apparently both effective in killing fungal spores, and harmless to the budwood. More recent work, however has shown that clones vary greatly in their susceptibility to damage by immersion in copper sulphate, and it is now clear that this fungicide could not be used as a general budwood disinfectant, at any rate at the concentrations previously tested. It was at this inconclusive stage that the investigations had to be abandoned owing to the prior claim of other duties.

The matter of disinfecting budwood has also received the attention of the Rubber Research Institute of Malaya, and a report entitled "The Effects of Certain Fungicides on the Viability of *Hevea* Buds" was recently published in the Quarterly Journal of that Institute. The report shows that certain chemicals can safely be used for disinfecting budwood. The investigations, however, were admittedly incomplete, and the Rubber Research Institute of Malaya is not yet in a position to recommend a treatment which will be effective, harmless to all clones, and easy and cheap in practical application.

PRESENT REGULATIONS

The present regulations governing the import of *Hevea* material into Ceylon prohibit absolutely the introduction of any seeds or plants from the Western Hemisphere. In order to import material from the Eastern Hemisphere a permit in writing must be obtained from the Director of Agriculture, Ceylon, and the material must be accompanied by a certificate of freedom from pests and diseases issued by the exporting country. The Inspector, Plant Fumigatorium, Colombo, may unpack and inspect any consignment, but in the case of budwood this inspection is usually waived in order that the budwood may reach the estate with the minimum delay.

The regulations ensure that no actually diseased budwood or budded stumps shall be introduced, since the material has to be carefully inspected in the country of export. They do not, however, prevent the entry of harmful fungi which may be in a dormant state on the surface of the budwood or even in the packing material, since the most careful inspection would not

expected to reduce the cost materially. Reduction of manufacturing costs is more likely to result from the use of the most efficient equipment and the concentration of manufacture in comparatively large factories.

SELLING ON APPEARANCE

The writer holds no brief for the practice of selling rubber on appearance and agrees that it would be much more satisfactory to market the product on the basis of quality as indicated by physical tests but the present system of grading can only be altered when both manufacturer and producer are in a position to deal on the basis of quality rather than appearance. If a Ceylon producer was offered a contract for rubber with a time of vulcanisation of 100-120 minutes, a mastication number of 80-100, and ageing properties showing less than 10 per cent. reduction of tensile strength after 96 hours' artificial ageing, all under specified conditions, he would not be in a position to accept it at the present time. There is a growing tendency for manufacturers to contract for the product of estates which they know suits their purpose and this may gradually develop into a system of selling on quality rather than appearance.

Until quality replaces appearance as a basis of sale it is fairly logical for the buyer to assume that rubber of good appearance results from careful and uniform methods of manufacture and that defects such as discolouration of crepe and mould, rust, bubbles, etc. in smoked sheet indicate irregularities in preparation which may lead to difficulties in subsequent manufacturing operations, and to value the product accordingly.

It is not so much the system of selling on appearance which causes dissatisfaction to producers as the comparative abuse of the system. The standard basis of sale on contract is "fair average quality" (appearance), which should be a fairly stable standard, but there is too great a tendency to vary the standard according to market conditions. At the present time when the current market price stands at several cents below the figure at which contracts were booked some months ago, the buyer is inclined to translate F. A. Q. as "superfine" quality and to reject rubber which is genuinely fair average quality. In fairness to the manufacturer it must be stated that many of the discounts which are imposed for slight blemishes in the rubber represent so much extra profit to the dealer and are not reflected in the price which the user pays for his supplies.

ADJUSTMENT OF EXISTING PROCESSES

The most disappointing factor of present methods of manufacture and marketing is that, in spite of the care taken to produce rubber of good appearance, the manufacturer is not fully satisfied with the properties of high grade plantation

rubber. His main complaint is that there is too much variation in the properties of different batches of the material. Variation in rate of vulcanisation and in ageing properties is less important now than formerly since these differences are largely adjusted by the use of accelerators and anti-oxidants in manufacturing processes. The factor which causes most trouble is the variation in hardness of the rubber, that is variation in the amount of milling required to soften the rubber sufficiently to mix in other compounding ingredients. When it is stated that occasional batches of rubber may vary by 50 per cent. from the average it will be understood that the difficulty is a real one.

Unfortunately for the plantation industry the manufacturer is inclined to meet the difficulty by replacing a proportion of high grade rubber by lower grade material such as "reclaim" and "Singapore blanket" which he knows to be uniformly soft. If the uniformity of plantation rubber could be relied on it would do much to stimulate the use of increased quantities of the material.

Experiments carried out by the Rubber Research Scheme [1] have shown that variation in the product of an individual estate can be limited to about 10-12½ per cent. on either side of the mean by careful standardisation of manufacture but there is also considerable variation in the properties of rubber from different estates arising from inherent differences in the latex. The variability of plantation rubber could be greatly reduced by concentrating manufacture in large factories so that latex from a number of estates could be bulked together.

The Research Scheme has recently been experimenting on hot water treatment of crepe rubber with a view to improving plasticity. Tests carried out up to the present have given satisfactory results and it seems likely that this will prove a practicable and economical method for reducing variability in this direction. Incidentally, and perhaps of greater interest to producers, the treatment minimises discolouration of crepe rubber during drying and storage. Methods are also being considered for preparing a hard grade of rubber which is useful for certain purposes and rubber with a low content of serum substances for electrical insulation.

The possibility of marketing unsmoked sheet was investigated some time ago, in view of the increasing scarcity of firewood for smoking [2]. Since it is considered impracticable to dry sheet rubber at ordinary temperature under estate conditions the possible advantage of preparing unsmoked sheet depends on the cost of different fuels. Firewood was considered to be the cheapest fuel up to a price of Rs. 2·50 per "yard" but above that price it becomes cheaper to dry over coke stoves or by

radiation from steam pipes using coke as fuel for the boiler. It was shown that smoke, as distinct from heat, can be produced with a very small consumption of firewood so there is no particular advantage in producing unsmoked sheet unless the manufacturer shows a preference for this grade.

It has recently been proposed in Malaya to roll sheet rubber sufficiently thin to be air dried at ordinary temperature, as a substitute for crepe rubber, and it is understood that this grade is being prepared on a few estates. The saving of fuel may compensate for the increased amount of machining, but it is uncertain up to the present whether the product will prove a suitable substitute for pale crepe for the maufacture of light coloured articles.

ALTERNATIVE FORMS OF MANUFACTURE

Hopkinson Process

The present standard methods of manufacture depend on coagulation of the latex and subsequent rolling of the coagulum. The only fundamentally different method of obtaining rubber from the latex is to remove the water by evaporation. A process for this purpose, analogous to the evaporation of milk, was developed some years ago by Hopkinson and has been worked on a large scale on the well known H. A. P. M. estates in Sumatra. The latex is sprayed in a finely divided form into a heated air chamber and the particles of rubber fall to the ground where they adhere, to form a spongy mass of rubber. This is pressed into blocks and is then ready for export.

Since the moisture is removed by evaporation it follows that the non-rubber substances present in the latex, amounting to 7-8 per cent., remain in the rubber and their presence confers both advantages and disadvantages on the product. Ageing properties are materially improved but the rubber absorbs moisture more readily and is not suitable for certain purposes. Manufacturers have had opportunities for testing this material but have shown no disposition to favour its adoption as a standard grade of plantation rubber.

No information has been published regarding the cost of this process of manufacture but it appears unlikely that it would be substantially cheaper than present methods.

Rubber Powder or Crumb

As a development of the above process an invention has recently been announced, from Holland, by which the particles of rubber obtained by spraying the latex are prevented from adhering and the rubber is obtained in the form of powder. This is an entirely novel product and claims have been made

that its use will reduce manufacturing costs in certain existing processes by eliminating mastication and will facilitate the use of rubber in various new directions, such as for road surfacing, the linoleum industry, etc. So far both the preparation and utilisation of the material are only at an experimental stage but there appear to be interesting possibilities for development. It will be noted that this product contains all the non-rubber substances present in the latex so can be expected to have the advantages and disadvantages associated with "whole latex" rubber.

Independently of the above process the London Staff of the Research Scheme has devised a method for the preparation of rubber in the form of crumb which can be put to the same type of use as rubber powder. This process involves coagulation of the latex so the product will have similar properties to the ordinary grades of plantation rubber. Samples of the material are being distributed to manufacturers and development of the process will depend on whether the product proves to have advantages over other forms of plantation rubber. It is anticipated that this method of preparation would be somewhat more expensive than crepe manufacture.

Preserved Latex

Apart from coagulation and evaporation of the latex another alternative is to market the rubber in the form of latex, suitably stabilised to prevent coagulation. The direct use of rubber latex in industry has increased rapidly in the past few years and there is every prospect of continued extension of its use, both for replacing other forms of raw rubber in certain existing processes and for extending the use of rubber in new directions.

Until recently the latex, preserved with ammonia, was shipped at the ordinary field concentration of 35-40 per cent. but various processes have been developed for concentrating the latex prior to export and two of them are being operated on a large scale in Malaya. The "Revertex" process involves the evaporation of water from the latex by heat after addition of an alkaline stabiliser, the product being a paste containing about 75 per cent. rubber. The "Utermark" process, the patent rights of which are held by the Dunlop Company, depends on the removal of water from the latex by centrifugation in a machine of the milk separator type and gives a product, similar in consistency to field latex, containing about 60 per cent. rubber. The two products differ in type since "Revertex" contains an increased proportion of serum substances whereas "Dunlop 60 per cent. latex" contains a reduced proportion. It seems likely

NOTES ON THE AFTER-TREATMENT OF BUDDED RUBBER STOCKS

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IN an article on budgrafting contributed jointly with Mr. R. K. S. Murray to the Rubber Research Scheme *Fourth Quarterly Circular* for 1931 reference was made to the practice of protecting the cut surfaces of budded stocks with a mixture of Asphalt and Kerosene. Observations made at the Experiment Station, Nivitigalakele during the past year have indicated however that the mixture is not entirely satisfactory either as a waterproof covering or as a protection against wood-rotting fungi, confirming the opinion expressed in the Annual Report of the Rubber Research Institute of Malaya for 1931. An experiment to compare various methods of treatment was initiated at Nivitigalakele in June 1932, and it is the purpose of these notes to record and comment on the results obtained so far. In doing so it may also be of interest to offer some remarks on the past history of treatment of budded stocks at Nivitigalakele in order to indicate the increasing importance which has been attached to the treatment of the cut surfaces, especially when the stocks are comparatively large.

PAST HISTORY

In the 1926 clearing which is the oldest in the Station the practice was to cut the stock down (after it had been successfully budded) to within 6 inches of the bud-patch and to leave the six inches of stock above the bud-patch, commonly called the "snag" eventually to dry and fall off. This was sometimes more expeditiously effected by kicking the snag over after it had sufficiently withered. If the stocks are young and vigorous, callusing proceeds rapidly and the treatment may prove quite satisfactory but there is obviously a risk of infection by wood-rotting fungi, which start on the decaying snag and may spread to the healthy stock and scion. The risk is likely to increase if the plants are lacking in vigour or are comparatively large at the time of budding. If a hollow is left when the snag falls off, which is not unusual, or is formed by subsequent decay, water collects and further decay is accelerated.

In the 1927 and part of the 1928 clearing the stocks were cut back to six inches above the bud-patch and a coating of wood tar applied to the cut surface. Some months later when the bud shoot had grown sufficiently to show about 2 feet of brown bark, the snag was sawn off with a sloping cut on a level with the bud-shoot and the cut surface again treated with tar. The same treament was applied to supplies which were put out to replace budding failures in the 1926 clearing.

A further development in treatment was introduced in later buddings in the 1928 clearing when tar, as a result of its lack of elasticity and liability to crack, was replaced by a mixture of Asphalt and Kerosene referred to above. In addition the cut surface, after removal of the snag, was painted with a 10 per cent. solution of Brunolinum plantarium some hours before application of the waterproof covering. The Asphalt-kerosene mixture in turn has not proved to be entirely satisfactory and has led to the series of experiments recorded in this report.

TREATMENT OF DISEASED STOCKS

Decay of the cut surfaces of budded stocks has occurred to some extent in all the clearings on the Station and early in the present season it was decided to make a tree to tree examination and to treat all infected surfaces in order to prevent further decay and to facilitate callusing of the stocks. It is of interest to note that in many cases the exposed wood surface appeared quite sound when examined superficially but careful inspection showed that the wood was soft and tindery underneath. After preliminary trials and pending more definite information from the experiments which have been initiated, the following method of treatment was adopted. All rotted tissue was scooped out down to clean wood and the surface painted first with a 10 per cent. solution of Brunolinum plantarium, and after drying, with Skene's pruning mixture. If after scooping, a hollow remained in which water could lodge, it was filled up with a mixture of one part "Colas" and two parts sand kneaded into a form of putty.

Treatment has been carried out in all three clearings but has only been completed in the 1926 clearing. Of 1,218 trees in this clearing 919 were budded in the field and 299 were budded in the nurseries and subsequently transplanted, ("supplies"). Of those budded in the field 389 were treated as described above and 530 did not require treatment. Of the 299 "supplies" 150 were treated and 149 did not require treatment.

The treated plants were divided into the following groups:

	Budded plants	Supplies
Stock (only) affected to depth of less than 1 inch	72	54
Stock (only) affected to depth of more than 1 inch	269	80
Scion (only) affected	10	0
Stock and scion both affected	38	16
	389	150

Comparison of the figures might suggest that the method of treatment has had little effect in preventing decay since the snags of most of the buddings were allowed to drop off whilst most of the supplies had the snags sawn off. It must however be remembered that supplies take some time to become fully established and would be expected to be less resistant to attack by wood-rotting fungi. A better comparison on this point can be made when figures are available for the experimental trees which are under special observation.

From the relatively large number of trees which have been treated it might be supposed that the general condition of the trees in the clearing is unsatisfactory but this is not the case. The trees are growing well and a number are already being test-tapped. Many trees which were treated had, at the time of treatment, already callused over except for a small hole in the centre in which water could lodge. The Colas filling which was applied squeezes out as callusing proceeds and the extent to which this has occurred in the past few months shows that rapid healing is taking place.

The object in presenting the figures at the present time is to emphasize the value of periodical inspection of budded plants, renewal of the waterproof cover on the cut surface of the stock and the early treatment of any which show signs of decay. The liability to decay occurs in the period before the bud shoot is sufficiently developed to maintain the vigour of the plant but once a hollow forms which can hold moisture it is difficult for the plant to resist further decay in spite of increasing vigour. Earlier treatment of the plants in this clearing would doubtless have prevented the comparatively large number of cases in which decay had extended to a depth of more than an inch.

General observation at the Experiment Station and on estates indicates that careful waterproofing of the cut surface of the stock is of considerable value in preventing decay but that the more important factor is the state of vigour of the plants. An appropriate application of a manure mixture a few months

before budding for instance will go a long way in ensuring successful callusing of the joint of stock and scion.

EXPERIMENTAL

In view of the somewhat undesirable number of budded plants which have become decayed to a greater or less extent at the snag joint a series of field experiments was undertaken in June 1932 to ascertain:

(1) how best to treat joints which had already commenced "rot" and in some cases had penetrated several inches down into the stock or up into the scion, and

(2) what form of treatment would be most effective for adoption immediately upon de-snagging in order, if possible, to prevent rot starting at all.

PART I

Layout.—Part I of the experiment was replicated in all three clearings and 12 trees were allotted to each treatment. Plants were selected from actual infected specimens (except for controls) growing in the field according as they most suited the treatments undertaken. Each specimen was marked with a tar band and its number recorded with particulars and sketches of the infected area. All plants used for the experiment had to be budded plants where stocks had already been cut down some time previously and whose scions were fairly advanced in growth, allowing sufficient time for the rot to develop. The treatments were as follows:

A. 12 untreated with cut surface of snag healthy. Control.

B. 12 untreated with cut surface of snag soft and infected. Control.

C. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium and painted with Skene's pruning mixture.

D. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium, and painted with "Colas".

E. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium, painted with Skene's pruning mixture, and filled with cement (1 cement to 2 sand) and shaded.

F. 12 with soft and infected cut surface of snag scooped out down to clean wood, disinfected with a 10 per cent. solution of Brunolinum plantarium, painted with Colas and filled with a mixture of Colas and sand (1:2).

Treatments E and F were carried out on joints which, after scooping out, left a hole of anything from 1 to 8 inches deep in which water could collect and treatments C and D on joints where infection was of a more superficial nature leaving no deep hollow for the accumulation of rain water.

Observations to date.—An inspection of the plants was made in Nov.-Dec., 1932 approximately 5 months after the experiment was started. The lots of control plants showed no detectable change in condition and will have to be left longer before obtaining the information that is required of them. They were included in the experiment with the idea of ascertaining whether lot A, left untreated, will in time develop infection, and whether the infection in lot B, similarly left, will tend to spread further with time. Choice between lots C and D at the present stage is difficult and observations show that both the Skene's mixture and Colas are satisfactory for the purpose for which they were used, namely for covering flat surfaces where water accumulation does not take place. The covering of Skene's mixture over the cut surface has formed into a hard, more or less impervious crust over the wood while that of Colas has subsided into a slightly softer layer. Skene's mixture however shows signs of greater adhesion, is easily applied and on the whole appears to be preferable. Colas has the advantage that it can be applied when the surface is damp. For the purpose of filling stocks containing cleaned-out holes although the cement filling in E has not proved definitely unsuitable the Colas-sand mixture in F has been considered preferable. The latter owing to its permanently soft consistency does not act as a deterrent against the closing up (by callus formation) of the hole and gets squeezed out as callusing develops. The cement, besides being unable to do this, tends on hardening to crack round the edges of the filling with the consequent danger of letting in water to the bottom of the hole and starting fresh rot. Even the provision of shade was not always successful in avoiding cracking. Moreover the "unshrinkableness" of the cement may tend to act as a definite deterrent against the speedy closing in of the hole if the filling is not done to perfection.

PART II

Layout.—For the second part of the experiment budded plants whose snags had been freshly cut down were utilised. The experiment was for this reason confined to the 1928 clearing.

The treatments were:

A. 24 plants with snags uncut. Control.

B. 24 plants with snags cut and Skene's pruning mixture applied over cut surface.

C. 24 plants with snags cut, disinfected with a 10 per cent. solution of Brunolinum plantarium and Skene's mixture applied over cut surface.

D. 24 plants with snags cut and treated with a mixture of "Entwas" wax and 5 per cent. by weight of powdered sulphur.

E. 24 plants with snags cut, disinfected with a 10 per cent. solution of Brunolinum plantarium and treated with a mixture of "Entwas" wax and 5 per cent. by weight of powdered sulphur.

F. 24 plants with snags cut, and treated with a mixture of Asphalt and Kerosene (1:1)

G. 24 plants with snags cut, disinfected with a 10 per cent. solution of Brunolinum plantarium and treated with a mixture of Asphalt and Kerosene.

Observations to date.—Here again the control group, at time of examination, had not had time to produce results, and the snags though in a more advanced stage of decay than in July (when started) were not sufficiently withered to fall off or to be kicked over. Until such stage is reached one is not able to state definitely whether leaving the snag to fall off results in wood-rot spreading from the dying snag to the healthy tissue of the stock and scion. Lots B and C again showed that the Skene's mixture had maintained the surfaces treated with it in a satisfactory condition up to the present stage and had formed the same hard crust over the wood which was described earlier. As compared with B & C, lots D & E have proved disappointing. The Entwas-sulphur layer has in many cases almost entirely disappeared from the cut surface of the stock (i.e. at the end of 4 months from application) having melted and poured down its sides, sometimes leaving a dark mould in its place. It was observed that by 10 a.m. on a hot day the mixture began to melt unless shade was provided. A further disadvantage is the formation of bubbles on the surface of the mixture a few days after application. Eventually these bubbles break leaving

Fig. 1

Cut-surface of budded plant in 1926 clearing apparently healthy but found on inspection to be decayed.

Fig. 2

Same plant as in Fig. 1 with diseased cut-surface cleaned out to depth of 1 inch.
Pieces of diseased tissue are seen on ground.

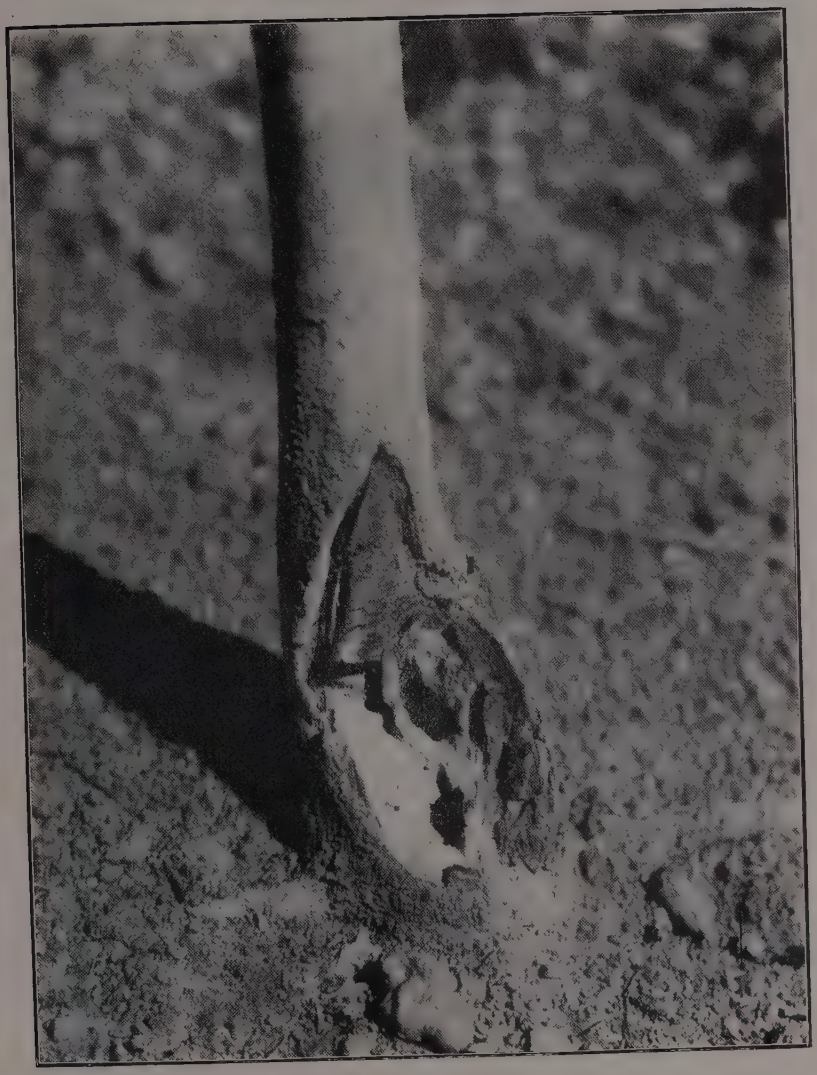

Fig. 3

Budded plant in 1928 clearing with rot at joint spreading both up into the scion and down into the stock.

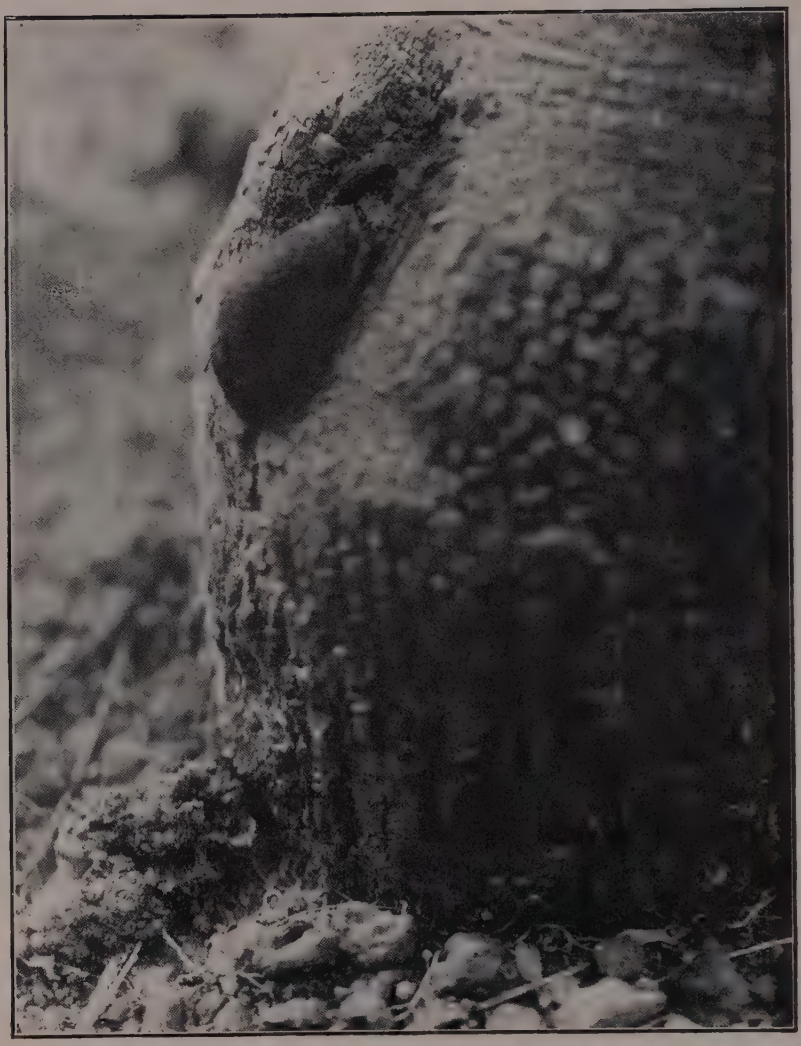

Fig. 4

Diseased joint of a budded plant in the 1926 clearing scooped out and filled with mixture of "Colas" and sand, showing mixture squeezing out as callusing proceeds.
Taken 3-4 months after filling.

exposed patches of bare wood and causing flaking away of the area immediately around them by rain. Bubble formation is caused by the exudation of sap from the surface of the cut stock and may occur even after allowing an interval of 14 days between cutting down and application of the wax mixture. Accordingly in the light of present experience and on account of the more tedious preparation of the wax mixture and the provision of shade required by it, which is not always convenient to supply, it has been decided to adopt the Skene's treatment as general practice at Nivitigalakele in preference to the wax-sulphur mixture. It should be mentioned that callus formation with the latter is very marked although the former is not deficient in this respect. It is preferable that the Skene's mixture be renewed every 6 months. Lots F & G at the present stage show no change worth recording. They were only started in August 1932.

CONCLUSION

The remarks made in this article are not intended to present a complete thesis on the treatment of stocks but rather to outline experience gained and observations made at the Experiment Station, Nivitigalakele. The experiments are still in a half-way stage and the conclusions essayed in certain instances are therefore subject to revision.

R. R. S. Laboratories,
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14th December, 1932.

A CHANGE-OVER EXPERIMENT IN RUBBER TAPPING*

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INTRODUCTORY

THE experiment here described was started on the Experiment Station, Peradeniya on April 1st, 1926. 384 trees were used and these were divided into 24 plots of 16 trees each. In eight of the plots the cut was not changed over until the end of the panel was reached in three years, in eight plots the cut was changed over annually on April 1st and in the remaining eight plots the cut was changed over every six months, on April 1st, and October 1st.

It is a widely held theory that changing over the tapping cut results in better bark renewal, and it was mainly to test the correctness of this theory that this experiment was started. A system was worked out for the periodical measurement of the thickness of the renewed bark when this bark was one year old in each case. Three such measurements were taken in each treatment, and on each occasion an additional measurement of the untapped bark at two feet from the ground was made. The final criterion of bark renewal was taken to be the percentage which the average thickness of renewed bark formed of the average thickness of the untapped bark in the same plot.

Separate records of the yield of dry rubber from each plot were maintained—in this case no comparison could be made till the end of the six year period, since during that period the cuts in the three different treatments were at different heights from the ground.

BARK RENEWAL

Table I shows the average thickness of renewed bark in millimetres one year after the bark at that point has been tapped together with the average thickness of the untapped bark at two feet from the ground and the former figure expressed as a percentage of the latter.

* Reproduced from *The Tropical Agriculturist* December, 1932. The experiment was arranged in conjunction with the Rubber Research Scheme (Ceylon).

Table 1

BARK RENEWAL MEASUREMENTS

Average of all Plots

	No Change-over			Change-over once yearly			Change-over once in six months.		
	Thickness of renewed bark	Thickness of untapped bark	Thickness of renewed bark expressed as percentage of untapped bark	Thickness of renewed bark	Thickness of untapped bark	Thickness of renewed bark expressed as percentage of untapped bark	Thickness of renewed bark	Thickness of untapped bark	Thickness of renewed bark expressed as percentage of untapped bark
	mm.	mm.		mm.	mm.		mm.	mm.	
1st Measurement	4.77	6.96	68.5	4.37	6.77	64.5	5.44	9.16	59.3
2nd Measurement	5.79	8.38	69.0	5.60	8.78	63.7	4.72	8.80	53.6
3rd Measurement	5.83	8.33	70.0	4.97	9.19	54.0	6.00	9.69	61.9
Average of 3 measurements	5.46	7.89	69.1	4.98	8.24	60.7	5.38	9.22	58.4

It must be borne in mind that the accurate measurement of bark thickness is not very easy, but in view of the fairly large number of trees employed the averages can be accepted with fair confidence.

It is apparent that even in actual average thickness of renewed bark the no-change-over plots are slightly superior to either of the others, and when these figures are expressed as percentages of untapped bark the superiority is increased.

The results of this experiment, therefore, do not in any way support the theory that changing over the cut once or twice a year results in better bark renewal.

The differences in average bark thickness are small and the figures probably indicate that the different treatments have not affected bark renewal one way or the other.

YIELD

Table 2 gives the average yields per tree for the three treatments for each year.

Over the whole period the change-over-once-yearly treatment has given the highest yield while the change-over-twice-yearly treatment comes second. The differences however are so small that it is doubtful if much significance can be attached to them.

Table 2

Average yields of dry rubber per tree

	No Change-over	Change-over once yearly	Change-over once in six months
	lb.	lb.	lb.
1926-27	5·29	5·26	4·76
1927-28	4·72	4·85	4·51
1928-29	4·68	4·62	4·48
1929-30	5·13	5·38	5·20
1930-31	6·24	6·47	6·88
1931-32	7·17	7·96	7·81
Total	33·23	34·54	33·64

SUMMARY AND CONCLUSIONS

1. An experiment was carried out with the main object of comparing the bark renewal on rubber trees on which (1) the tapping cut was not changed over till the end of the panel was reached in three years, (2) the cut was changed over once a year, (3) the cut was changed over once in six months. Separate yield records were also maintained.

2. It was found that the bark renewal measurement figures obtained in the experiment gave no support to the theory that changing over the cut resulted in better bark renewal. The highest average figure for thickness of renewed bark was obtained in the no-change-over plots. The differences are small and it may be assumed that the different treatments have not influenced the rate of bark renewal.

3. Changing over the cut has not resulted in any loss of yield. The highest yield was obtained from the change-over-once-yearly plots but it is doubtful if this superiority is due to the treatment.

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